



Adopting a Successful TV Whitespace Regulatory Framework

Key Consideration for TVWS Implementation

n **Protect Incumbent Operations**

- § Licensed TV
- § Licensed Part 90 operations in channels 14-20
- § Ad hoc Part 74 auxiliary broadcast operations licensed by rule
- § Authorized wireless microphones, to the extent possible

n **Meet User Needs**

- § Maximize spectrum access within necessary protection requirements
- § Accommodate both enterprise business and consumer needs
- § Enable fixed, mobile and portable use
- § Minimize potential for interference to CATV wiring/set-top boxes for in-home TVWS uses

n **Enable “Future-Proof” TVWS Deployment**

- § Provide for mechanism to adjust deployed TVWS devices as environment changes and market gains real world experience

Feb. 27, 2008

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Motorola's Multi-tiered Approach

- **Geolocation database – Access database to determine available channels and permissible operating parameters**
 - Highly reliable approach to protection – not susceptible to challenging RF environment
 - On going control of devices
 - Protection requirements can be modified over time if necessary
 - Third Party database facilitates control and rapid updates
- **Sensing**
 - Facilitates sharing among TVWS devices
 - Provides additional protection by sensing any transmissions not listed in database
- **Support for Beacon**
 - Provides real-time priority in limited area

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Two Tiers of Devices

- **High Power devices**

- Up to 4 Watts EIRP
- Required to include Geolocation, Sensing and Beacon
- Fixed, Mobile, Portable

- **Low Power devices**

- 10 mW or less
- Sensing and Beacon only
- No operation on Chs. 14-20

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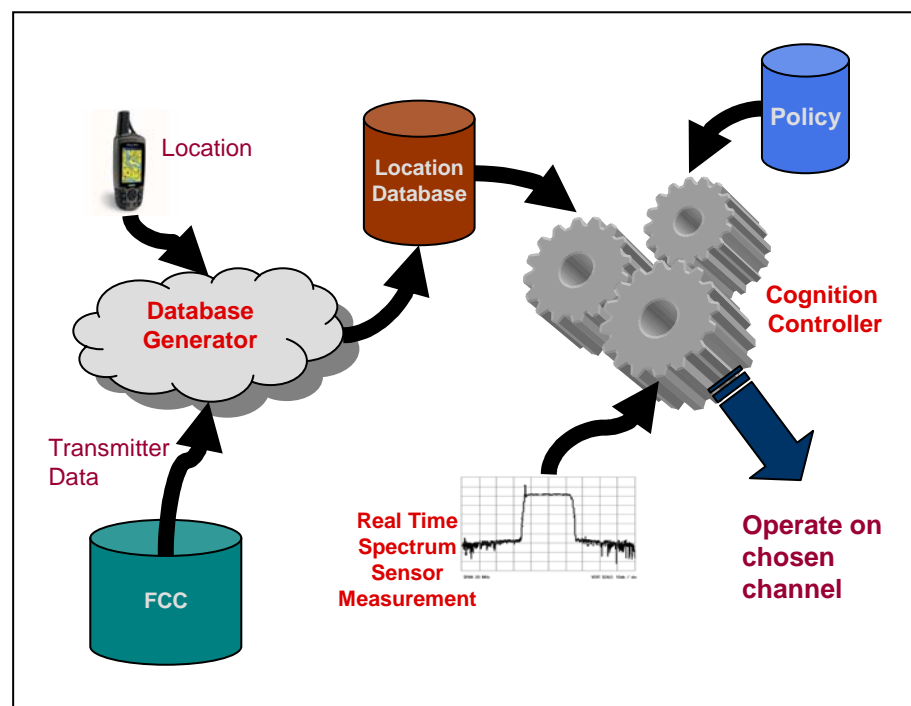


Geolocation Provides Protection of Incumbent Users

How it Works (1):

- n TVWS Access Point (AP) determines location;
- n TVWS AP runs Geolocation program to determine allowable channels and power;
- n TVWS AP senses and selects the highest quality channel within the options allowed; and
- n TVWS AP sends control signal and beacon to client device.

Geolocation program is loaded with protection parameters per rules. Can be updated to “Future Proof” devices.



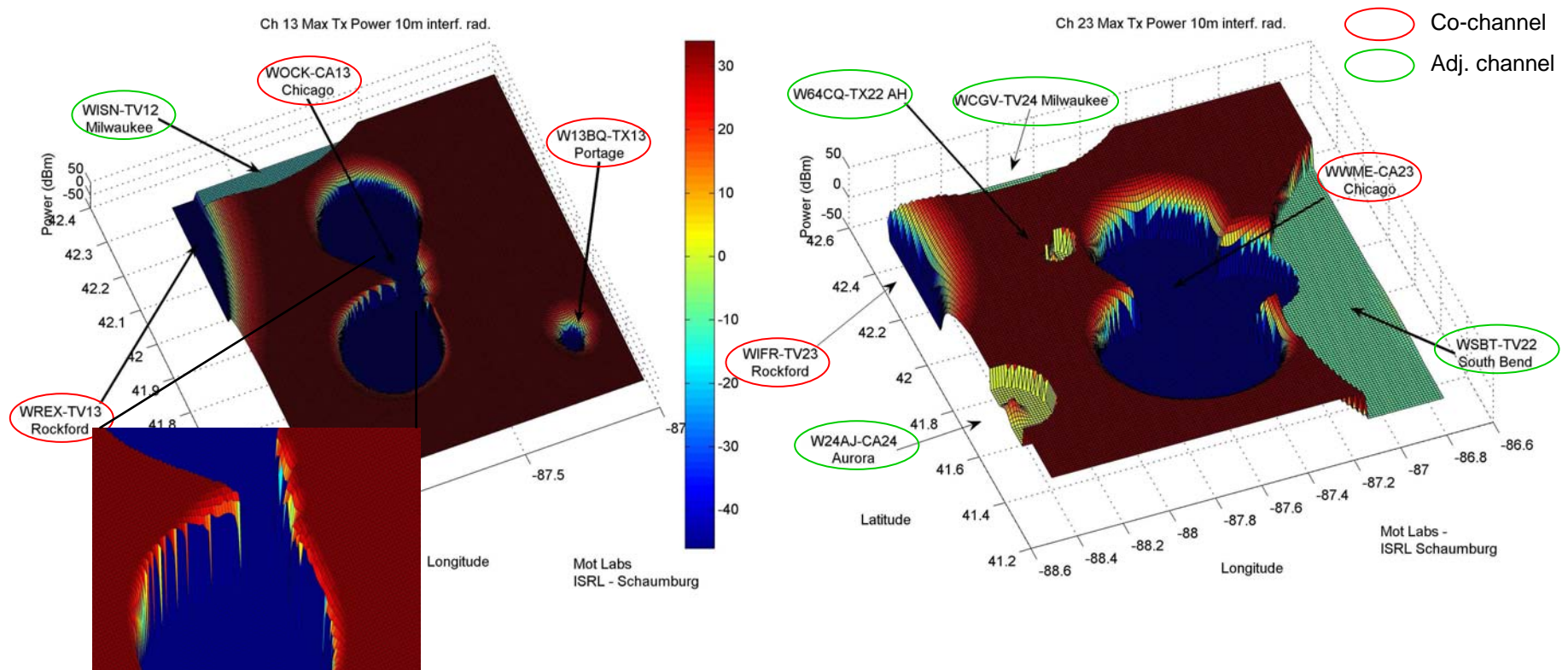
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Geo-location Database Modeling Examples

Max Allowed WSD EIRP vs. Lat-Long Coordinates



The charts show the **Max allowed EIRP versus location coordinate** for operation on TV channels 13 (left) and 23 (right) in the Chicago area

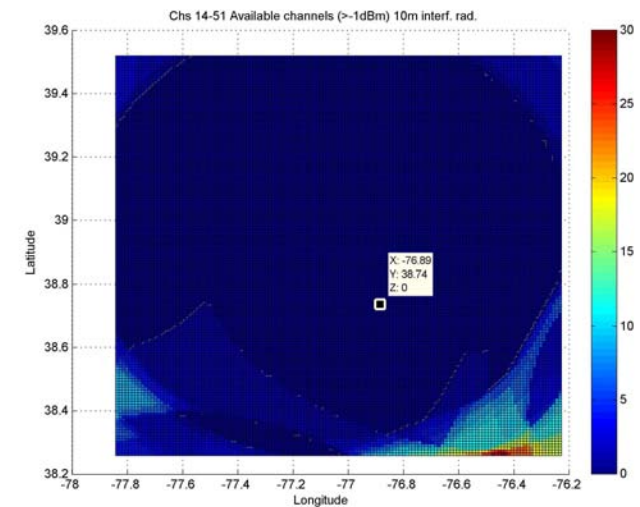
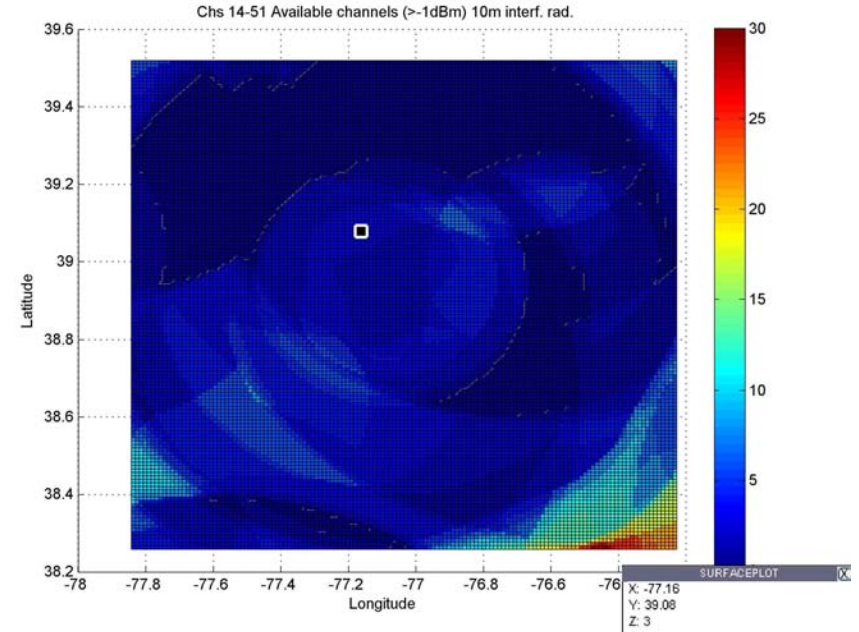
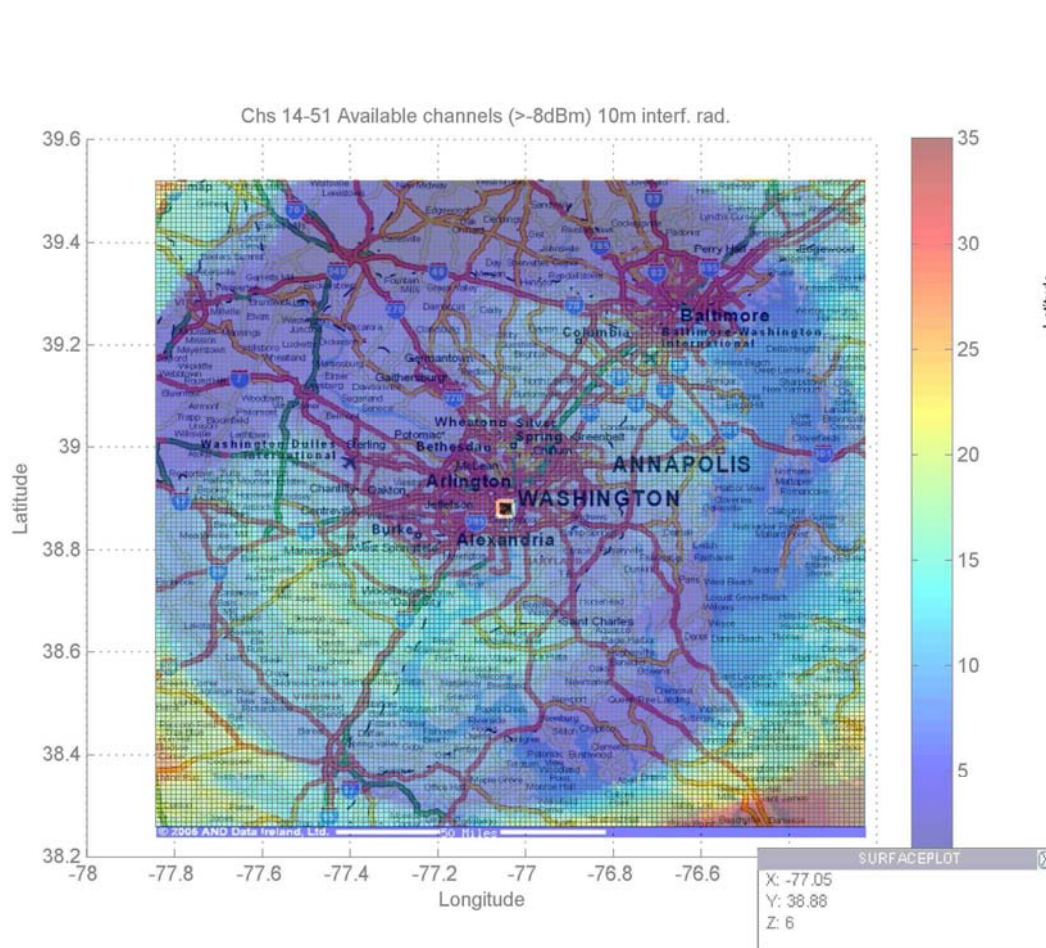
- § The color code indicates the allowed EIRP in dBm to satisfy various co- and adjacent channel interference criteria, taking into account the different protection requirements for different classes of licensed stations – also includes nearest contour edge modeling (shown in magnified region)
- § **Reddish-brown** indicates $>+30$ dBm, dark blue <-45 dBm (essentially unusable)

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DC Area Available TVWS channels



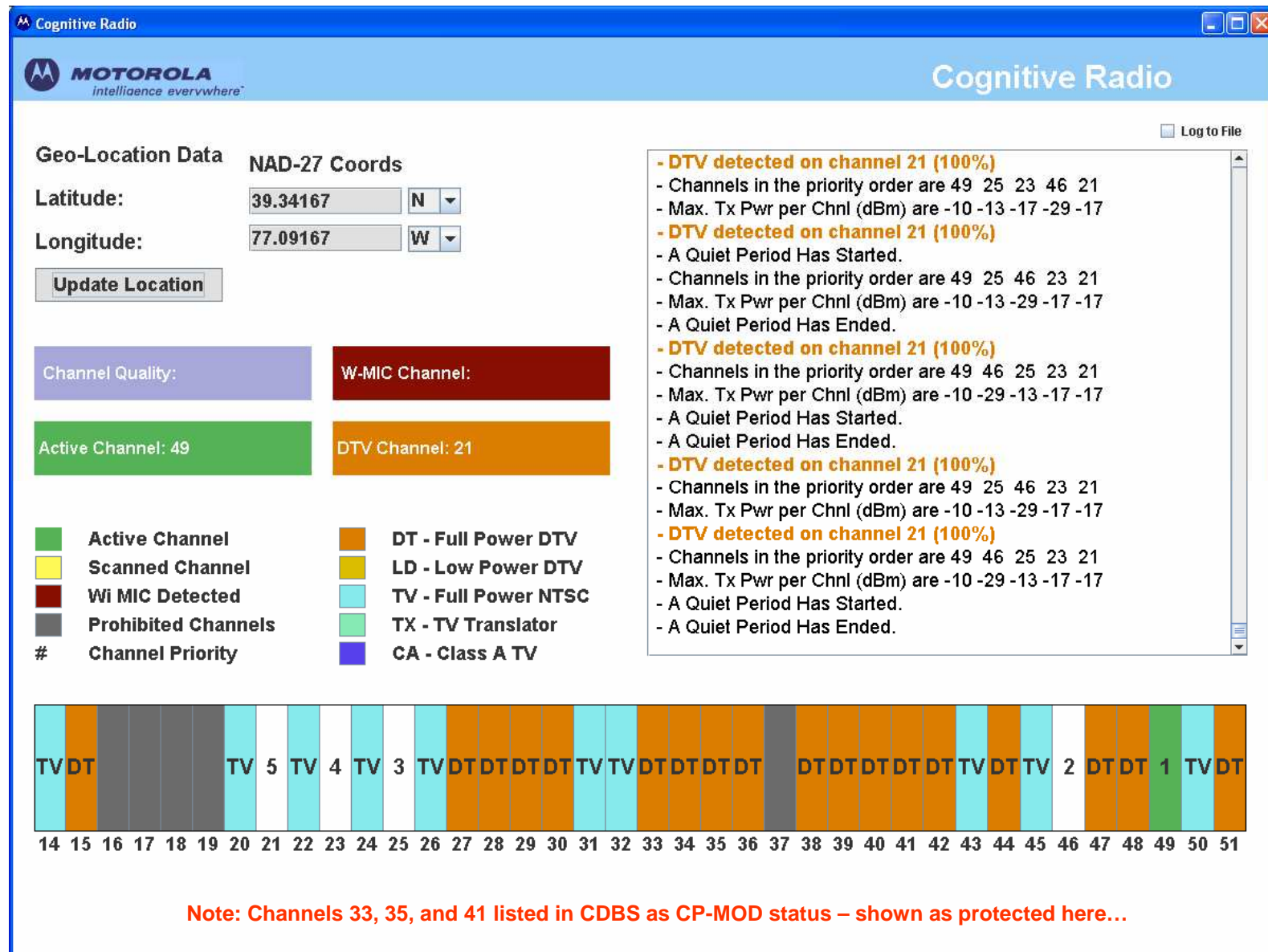
Notes:

- Maps shown for *current* TV band allocations
- Do not include CP-MODs that are on the air
- (Upper right doesn't attempt use of LMR adj. channels)
- (Lower right does not allow use of TV adj. channels)

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Sample Motorola WSD GUI (including protection for all CP-MODs)



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Sharing Between TVWS Devices

1) Registration in Geolocation data base

- Allow users to register unlicensed TVWS operations in geolocation database
 - § Nominal registration fee covers cost of maintaining database
- Geolocation enabled TVWS devices will recognize registered operations and will prioritize registered channels as last to be used
 - § Does not provide full protection, but minimizes potential for interference, facilitates sharing and reliable operation
 - § All TVWS devices have equal regulatory status
- Limit registration to two channels per user
 - § Additional channels can be used on an unregistered basis
 - § Prevents single user from dominating

2) Contention based operation

- TVWS devices should sense noise level on available channels and put highest priority on channels with lowest noise

Recommendations

- n **Adopt Multi-tiered Approach to Implementation**
- n **Prohibit any devices without geolocation in CH 14-20**
 - § Minimizes potential for interference to public safety and critical users
- n **Provide for 3rd party administration of data base**
 - § Allows Part 74 ad hoc operations and wireless mikes at major events to be added to database and protected for duration of event
 - § Allows protection for unique situations (e.g. cable head ends receiving distant signals)
- n **High power TVWS users to register to be added to database**
 - § Enables greater integrity for unlicensed operations and provides record if interference did occur
- n **Allow 4 watts power for fixed and mobile systems with geolocation**
 - § Provides useful power level for both rural broadband and most enterprise environments
- n **Low power 10 mW TVWS devices**
 - § Facilitate in-home networking
 - § Minimizes ingress of TVWS signals into CATV set-tops/wiring
- n **Require all devices to include sensing (directly or via tether)**
 - § Provides additional level of protection
 - § Facilities sharing among devices
- n **Require all devices to detect beacon signal (directly or via tether)**
 - § Provides additional protection and control of TVWS devices
 - § Enables protection for short term uses by incumbents or devices with higher regulatory priority